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ARE VERTICAL FARMS THE FUTURE?



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Are Vertical Farms the Future?

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Climate change is the driving force in evolution, which selects new life forms pre-adapted to changes in the environment. But the rate of change the world's climate is now subjected to has been in fast-forward mode for the last one hundred years. The accelerated rate of warming coincides with the advent of the Industrial Revolution and the widespread use of fossil fuels. Over the last quarter century, the world has witnessed a rapid decline in biodiversity in most terrestrial ecosystems, and the total number of species on the planet will be reduced even further as things heat up over the next fifty years. That we are the root cause of these unwanted changes is now obvious. As Pogo, that well-known comic-strip philosopher, once sagely observed: "We have met the enemy and they is us."

Health issues, quality of life, and even where we will live as sea levels rise over the next one hundred years are problems that we must face immediately if we are to survive as a species. Do we simply sit there on the tracks as the runaway climate train approaches? Creating a problem is one thing, but realizing the causes of the problem, then taking radical measures to correct it, is yet another. One solution to slowing down climate change is to grow most of our food crops indoors and give a significant portion of farmland back to nature. This would allow the land to repair itself. Many examples supporting this "no cost" mechanism for restoration of the environment already exist. For instance, in 1620, an estimated 90–95 percent of the Northeast was covered with hardwood forest; by the mid-1800s, 54 percent of New York and 67 percent of southern New England was either in pasture or plowed for food production. But

agriculture in the region largely failed due to the poor soil types and the long, cold winters. Nature eventually reclaimed the abandoned farmland, and today, forests dominate New England and New York State once again, occupying 72 percent of the landscape. The same has happened in the Korean peninsula's demilitarized zone, or DMZ. Created in 1953, this approximately 400-square-mile strip of land, established to act as a buffer between North and South Korea, has since become on its own a habitat for endangered animals and plants. There are numerous other cases that provide strong evidence for a "leave it alone" policy for environmental repair.¹

But we still need to feed some 6.8 billion people, with an additional three billion on the way by 2050, according to the United Nations. How can this be achieved without further encroaching into natural systems? The present iteration of indoor farming is not without its problems: They tend to be too far away from populated centers. Crops have to be harvested before ripeness and shipped many miles to reach the tables of urban dwellers, and consequently there is produce spoilage and the attendant loss of sales.

A new way of farming must replace what currently exists. Controlled environment agriculture (CEA) is one promising approach to solving this problem. It already exists in many places throughout the world, and has resulted in a string of commercially successful greenhouse operations, such as EuroFresh Farms in Wilcox, Arizona. Bringing food production inside the cities by stacking high-tech greenhouses on top of each



1. Harvested cornfield. © Roelof Bos/Getty Images

2. Hardwood forest, Great Smoky Mountains National Park. © Getty Images

3. Eco-Laboratory, building concept. Dan Albert, Myer Harrell, Brian Geller, and Chris Dukehart, Weber Thompson. United States, 2009



The top twenty cities in the United States have an agricultural footprint roughly equivalent to the state of Montana.



1. Eco-Laboratory, building concept. Dan Albert, Myer Harrell, Brian Geller, and Chris Dukehart, Weber Thompson. United States, 2009

2. Genetically mutated frog with five legs. © HO/Reuters/Corbis

3. Eco-Laboratory, building concept. Dan Albert, Myer Harrell, Brian Geller, and Chris Dukehart, Weber Thompson. United States, 2009

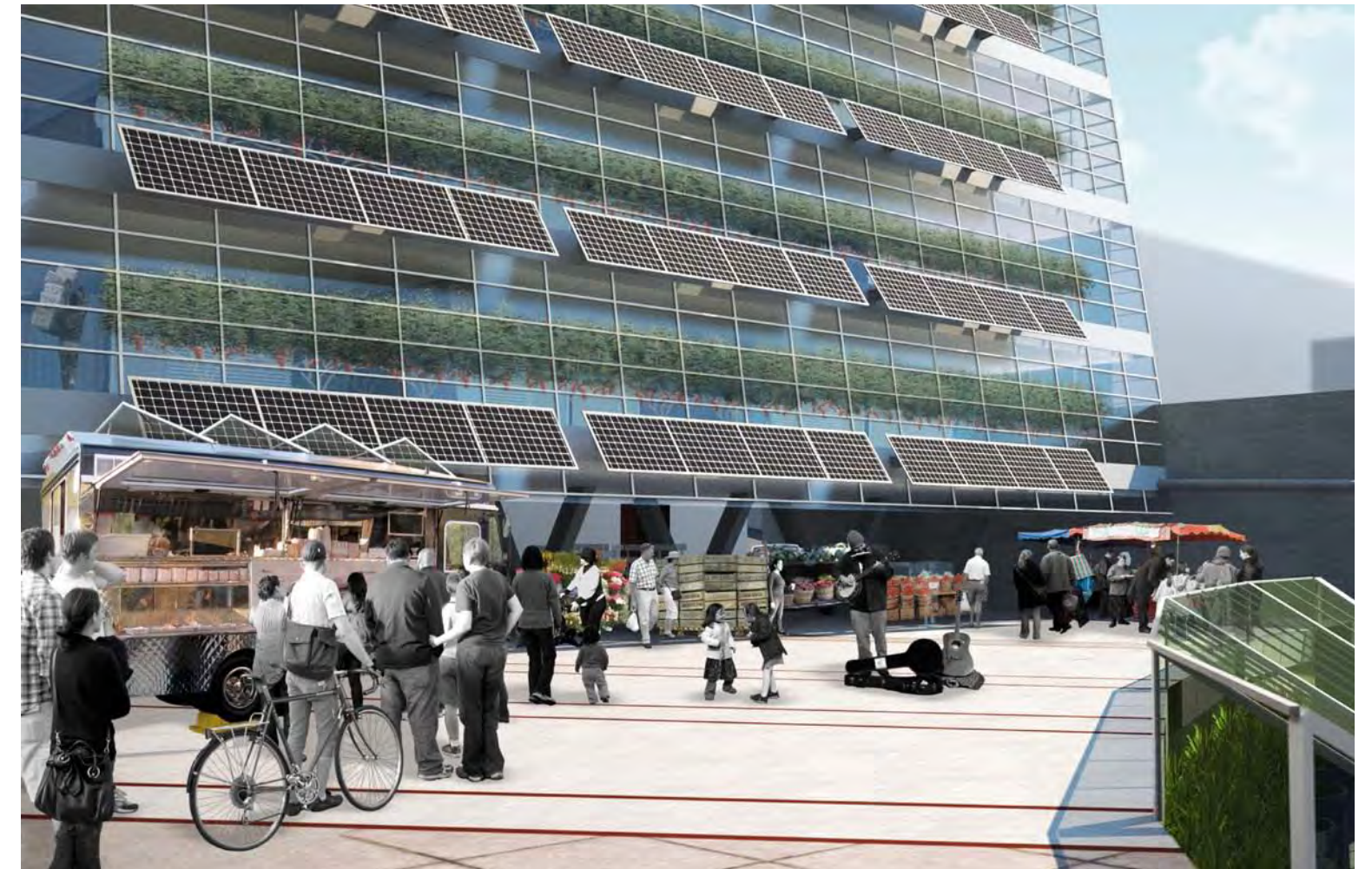
other can help overcome the above challenges. “Vertical farm” is the term I came up with for these high-rise farms. They have many potential virtues, among them the guarantee that we will always have an abundant, robust, and safe food supply where most of us choose to live. The vertical farming concept begins with a simple idea: grow food in a climate-controlled multistory building free of pollutants, pesticides, and seasons while producing the highest-quality produce in an urban environment. From ten-story structures to dragonfly wing-inspired behemoths that tower over Manhattan, vertical farms are but one of a host of solutions needed to address the complexities of bringing food to people.



The current exhibition at Cooper-Hewitt, *National Design Triennial: Why Design Now?*, features a prototype of a vertical farm, the award-winning Eco-Laboratory, a collaborative effort between myself and Weber Thompson Architects in Seattle. Our vision includes a multi-story experimental farm, an artificial wetland to remediate gray water, outdoor farm plots, and a community center. Once built, citizens who want to get involved in urban agriculture can come to the Eco-Laboratory and learn the ins and outs of urban-based outdoor and indoor farming, taught in hands-on applied courses featuring hydroponics, aeroponics, and aquaculture. The city of Newark, New Jersey, has expressed serious interest in seeing a prototype vertical farm built within the next year, and similar projects are underway in Chicago, Milan, Italy, and other densely populated centers throughout the world. The proposed Newark Vertical Farm represents an incorporation of integrated and overlapping sustainable design features. More than just a vertical farm, it is a research-and-development program for sustainable design in an urban context. Part demonstration project, part laboratory, the purpose is to provide a complex in which develop, test, and educate, with the ultimate goal of perfecting a commercially viable building type.²

How do we go about establishing a realistic, economically viable urban “ecosystem” within the techno-sphere, i.e., the built landscape? Establishing criteria for ecologically sound behavior will involve connecting disparate, cutting-edge technologies in ways yet untried. Fortunately, current methods for things such as pollution-free waste-to-energy strategies and safe gray-water reclamation are more than sufficient. So constructing a totally off the grid community is feasible, even though we have yet to do so. The time is right to make urban farming in tall buildings a reality. If we as a society do not choose to get out of our ecological mess, the human condition will surely further exacerbate already stressed and depleted natural systems, particularly hardwood forests. Increasing deforestation to make room for yet more farmland would permanently alter the atmosphere, causing traditional soil-based agriculture to catastrophically fail.

There are other immediate concerns linked to soil-based agriculture. Approximately 70% of the available freshwater on the planet is used for agricultural irrigation, which contaminates the water with agrochemicals (pesticides, fertilizers, and herbicides) and silt, rendering



it undrinkable. Many energy experts now value water more than oil, and warn that if current trends in water use continue, it will become unavailable.

Infectious diseases account for a significant number of deaths worldwide each year. Diarrheal diseases such as salmonella, cholera, and shigella are caused by ingesting food and/or water contaminated with fecal matter. Insect pests, rodents, and a wide variety of plant-pathogenic microbes, including rice blast wheat rust, also threaten food security. Because of these interlopers, what we harvest is never equal to what we plant; and some of what we harvest spoils on the way to market. Storage bins are perfect targets for all kinds of organisms that find their way into them and reap the benefits of our hard work. Rice farming in tropical areas of the world encourages water-borne illnesses like malaria and schistosomiasis. The common practice of using human feces as fertilizer in most of Southeast Asia, South Asia, and many parts of Africa and South America facilitates the spread of other parasitic infections (referred to as geohelminths). Hookworm, *Ascaris lumbricoides* (giant roundworm), and *Trichuris trichiura* (whipworm) are among the most commonly occurring worm infections, afflicting some 2.5 billion people and causing significant loss of work and capacity. Atrazine, a widely used anti-fungal agent intended to control wheat rust, is an endocrine disrupter in amphibians, and has produced large populations of three- and five-legged frogs throughout the wheat belt of the American Midwest. This will undoubtedly eventually affect us as well, since

frogs are remarkable predators of insect pests such as mosquitoes.

Reversing the harmful effects of a failing agricultural system on natural systems increases our natural capital, but doing so will require a dramatic reduction in our agricultural footprint. While cities have small land-use footprints, the city dweller’s agricultural footprint is huge. For example, New York City’s eight-million-plus inhabitants require agricultural land the size of Virginia to supply it with fresh produce and meat products. The top twenty cities in the United States have an agricultural footprint roughly equivalent to the state of Montana. A radical new approach to life in the big city is what is needed—true eco-urbanism, in which food production occurs within city limits. The vertical farm will only succeed if we all cooperate. The team must include as many talented individuals in architecture, engineering, agronomy, politics, economics, psychology, and microbiology as we can muster in a common effort to relieve the land of the stress of traditional farming. If all this comes to pass, balance between us and the rest of the natural world may be achieved.

Dickson Despommier, who coined the term “vertical farm,” is Emeritus Professor of Public Health and Microbiology at Columbia University. Author of *West Nile Story* and coauthor of *Parasitic Diseases* (5th ed.), he has also published dozens of articles and lectured widely on parasitic infections, infectious disease, and the concept of the vertical farm. His book *Vertical Farm: The World Is Growing Up* will be published by St. Martin’s Press in October 2010.

1. U.S. Department of Agriculture, Northeast Forest Regeneration Handbook (Newtown Square, PA: USDA Forest Service, July 2006): 4, 6.

2. Weber Thompson news release, July 23, 2010.